

Appendix A. Thermal Conversion Factors

The thermal conversion factors presented in the following tables can be used to estimate the heat content in British thermal units (Btu) of a given amount of energy measured in physical units, such as barrels or cubic feet. For example, 10 barrels of asphalt has a heat content of approximately 66.36 million Btu (10 barrels x 6.636 million Btu per barrel = 66.36 million Btu).

The heat content rates (i.e., thermal conversion factors) provided in this section represent the gross (or upper) energy content of the fuels. Gross heat content rates are applied in all Btu calculations for the *Monthly Energy Review* and are commonly used in energy calculations in the United States; net (or lower) heat content rates are typically used in European energy calculations. The difference between the two rates is the amount of energy that is consumed to vaporize water that is created during the combustion process. Generally, the difference ranges from 2 percent to 10 percent, depending on the specific fuel and its hydrogen content. Some fuels, such as unseasoned wood,

can be more than 40 percent different in their gross and net heat content rates.

In general, the annual thermal conversion factors presented in Tables A1 through A6 are computed from final annual data or from the best available data and labeled “preliminary.” Often, the previous year’s factor is used as a preliminary value until data become available to calculate the factor appropriate to the year. The source of each factor is described in the section entitled “Thermal Conversion Factor Source Documentation,” which follows Table A6 in this appendix.

Thermal conversion factors for hydrocarbon mixes (Table A1) are weighted averages of the thermal conversion factors for each hydrocarbon included in the mix. For example, in calculating the thermal conversion factor for a 60-40 butane-propane mixture, the thermal conversion factor for butane is weighted 1.5 times the thermal conversion factor for propane.

Table A1. Approximate Heat Content of Petroleum Products
(Million Btu per Barrel)

Petroleum Product	Heat Content	Petroleum Product	Heat Content
Asphalt	6.636	Natural Gasoline and Isopentane	4.620
Aviation Gasoline	5.048	Pentanes Plus	4.620
Butane	4.326	Petrochemical Feedstocks	
Butane Propane Mixture ^a	4.130	Naptha Less Than 401° F	5.248
Distillate Fuel Oil	5.825	Other Oils Equal to or Greater Than 401° F	5.825
Ethane	3.082	Still Gas	6.000
Ethane-Propane Mixture ^b	3.308	Petroleum Coke	6.024
Isobutane	3.974	Plant Condensate	5.418
Jet Fuel, Kerosene Type	5.670	Propane	3.836
Jet Fuel, Naphtha Type	5.355	Residual Fuel Oil	6.287
Kerosene	5.670	Road Oil	6.636
Lubricants	6.065	Special Naphthas	5.248
Motor Gasoline		Still Gas	6.000
Conventional ^c	5.253	Unfinished Oils	5.825
Reformulated ^c	5.150	Unfractionated Stream	5.418
Oxygenated ^c	5.150	Waxes	5.537
Fuel Ethanol ^d	3.539	Miscellaneous	5.796

^a 60 percent butane and 40 percent propane.

^b 70 percent ethane and 30 percent propane.

^c See Table A3 for motor gasoline annual weighted averages beginning in 1994.

^d Fuel ethanol, which is derived from agricultural feedstocks (primarily corn), is not a petroleum product but is blended into motor gasoline. Its gross heat content (3.539 million Btu per barrel) is used in *Monthly Energy Review* calculations; its net heat content (3.192 million Btu per barrel) is used in the Energy Information Administration’s *Renewable Energy Annual* calculations.

Source: See “Thermal Conversion Factor Source Documentation,” which follows Table A6.

Table A2. Approximate Heat Content of Crude Oil, Crude Oil and Products, and Natural Gas Plant Liquids
(Million Btu per Barrel)

	Crude Oil			Crude Oil and Products		Natural Gas Plant Liquids Production
	Production	Imports	Exports	Imports	Exports	
1973	5.800	5.817	5.800	5.897	5.752	4.049
1974	5.800	5.827	5.800	5.884	5.774	4.011
1975	5.800	5.821	5.800	5.858	5.748	3.984
1976	5.800	5.808	5.800	5.856	5.745	3.964
1977	5.800	5.810	5.800	5.834	5.797	3.941
1978	5.800	5.802	5.800	5.839	5.808	3.925
1979	5.800	5.810	5.800	5.810	5.832	3.955
1980	5.800	5.812	5.800	5.796	5.820	3.914
1981	5.800	5.818	5.800	5.775	5.821	3.930
1982	5.800	5.826	5.800	5.775	5.820	3.872
1983	5.800	5.825	5.800	5.774	5.800	3.839
1984	5.800	5.823	5.800	5.745	5.850	3.812
1985	5.800	5.832	5.800	5.736	5.814	3.815
1986	5.800	5.903	5.800	5.808	5.832	3.797
1987	5.800	5.901	5.800	5.820	5.858	3.804
1988	5.800	5.900	5.800	5.820	5.840	3.800
1989	5.800	5.906	5.800	5.833	5.857	3.826
1990	5.800	5.934	5.800	5.849	5.833	3.822
1991	5.800	5.948	5.800	5.873	5.823	3.807
1992	5.800	5.953	5.800	5.877	5.777	3.804
1993	5.800	5.954	5.800	5.883	5.779	3.801
1994	5.800	5.950	5.800	5.861	5.779	3.794
1995	5.800	5.938	5.800	5.855	5.746	3.796
1996	5.800	5.947	5.800	5.847	5.736	3.777
1997	5.800	5.954	5.800	5.862	5.734	3.762
1998	5.800	5.953	5.800	5.861	5.720	3.769
1999	5.800	5.942	5.800	5.840	5.699	3.744
2000	5.800	5.959	5.800	5.849	5.658	3.733
2001 ^a	5.800	5.959	5.800	5.849	5.658	3.733

^a Preliminary.

Note: Crude oil includes lease condensate.

Source: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A3. Approximate Heat Content of Petroleum Products, Weighted Averages
(Million Btu per Barrel)

	Consumption						Imports	Exports	Liquefied Petroleum Gases Consumption	Motor Gasoline Consumption
	Residential	Commercial	Industrial	Transportation	Electric Utilities	Total				
1973	5.205	5.749	5.568	5.395	6.245	5.515	5.983	5.752	3.746	5.253
1974	5.196	5.740	5.538	5.394	6.238	5.504	5.959	5.773	3.730	5.253
1975	5.192	5.704	5.528	5.392	6.250	5.494	5.935	5.747	3.715	5.253
1976	5.215	5.726	5.538	5.395	6.251	5.504	5.980	5.743	3.711	5.253
1977	5.213	5.733	5.555	5.400	6.249	5.518	5.908	5.796	3.677	5.253
1978	5.213	5.716	5.553	5.404	6.251	5.519	5.955	5.814	3.669	5.253
1979	5.298	5.769	5.418	5.428	6.258	5.494	5.811	5.864	3.680	5.253
1980	5.245	5.803	5.376	5.440	6.254	5.479	5.748	5.841	3.674	5.253
1981	5.191	5.751	5.313	5.432	6.258	5.448	5.659	5.837	3.643	5.253
1982	5.167	5.751	5.263	5.422	6.258	5.415	5.664	5.829	3.615	5.253
1983	5.022	5.642	5.273	5.415	6.255	5.406	5.677	5.800	3.614	5.253
1984	5.129	5.700	5.223	5.422	6.251	5.395	5.613	5.867	3.599	5.253
1985	5.115	5.660	5.221	5.423	6.247	5.387	5.572	5.819	3.603	5.253
1986	5.130	5.691	5.286	5.427	6.257	5.418	5.624	5.839	3.640	5.253
1987	5.095	5.659	5.253	5.430	6.249	5.403	5.599	5.860	3.659	5.253
1988	5.118	5.657	5.248	5.434	6.250	5.410	5.618	5.842	3.652	5.253
1989	5.057	5.615	5.233	5.440	6.241	5.410	5.641	5.869	3.683	5.253
1990	4.952	5.612	5.272	5.445	6.247	5.411	5.614	5.838	3.625	5.253
1991	4.912	5.591	5.192	5.442	6.248	5.384	5.636	5.827	3.614	5.253
1992	4.943	5.579	5.188	5.445	6.243	5.378	5.623	5.774	3.624	5.253
1993	4.943	5.573	5.200	5.438	6.241	5.379	5.620	5.777	3.606	5.253
1994	4.940	5.583	5.170	5.427	6.231	5.361	5.534	5.777	3.635	^b 5,230
1995	4.928	5.549	5.140	5.419	6.210	5.341	5.483	5.740	3.623	5.215
1996	4.871	5.497	5.136	5.421	6.212	5.336	5.468	5.728	3.613	5.216
1997	4.873	5.463	5.139	5.417	6.220	5.336	5.469	5.726	3.616	5.213
1998	4.844	5.447	5.156	5.416	6.220	5.349	5.462	5.710	3.614	5.212
1999	4.751	5.368	5.115	5.419	6.208	5.328	5.421	5.684	3.616	5.211
2000	4.760	5.395	5.089	5.427	6.193	5.326	5.432	5.651	3.607	5.210
2001 ^a	4.760	5.395	5.089	5.427	6.193	5.326	5.432	5.651	3.607	5.210

^a Preliminary.

^b Beginning in 1994, the single constant factor is replaced with a quantity-weighted average of motor gasoline's major components. See Table A1.

Note: Weighted averages of the products included in each category are calculated by using heat content values shown in Table A1.

Source: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A4. Approximate Heat Content of Natural Gas
(Btu per Cubic Foot)

	Production		Consumption			Imports	Exports
	Dry	Marketed	Sectors Other Than Electric Utilities	Electric Utilities	Total		
1973	1,021	1,093	1,020	1,024	1,021	1,026	1,023
1974	1,024	1,097	1,024	1,022	1,024	1,027	1,016
1975	1,021	1,095	1,020	1,026	1,021	1,026	1,014
1976	1,020	1,093	1,019	1,023	1,020	1,025	1,013
1977	1,021	1,093	1,019	1,029	1,021	1,026	1,013
1978	1,019	1,088	1,016	1,034	1,019	1,030	1,013
1979	1,021	1,092	1,018	1,035	1,021	1,037	1,013
1980	1,026	1,098	1,024	1,035	1,026	1,022	1,013
1981	1,027	1,103	1,025	1,035	1,027	1,014	1,011
1982	1,028	1,107	1,026	1,036	1,028	1,018	1,011
1983	1,031	1,115	1,031	1,030	1,031	1,024	1,010
1984	1,031	1,109	1,030	1,035	1,031	1,005	1,010
1985	1,032	1,112	1,031	1,038	1,032	1,002	1,011
1986	1,030	1,110	1,029	1,034	1,030	997	1,008
1987	1,031	1,112	1,031	1,032	1,031	999	1,011
1988	1,029	1,109	1,029	1,028	1,029	1,002	1,018
1989	1,031	1,107	1,031	1,030	1,031	1,004	1,019
1990	1,031	1,105	1,030	1,034	1,031	1,012	1,018
1991	1,030	1,108	1,031	1,024	1,030	1,014	1,022
1992	1,030	1,110	1,031	1,022	1,030	1,011	1,018
1993	1,027	1,106	1,028	1,022	1,027	1,020	1,016
1994	1,028	1,105	1,029	1,022	1,028	1,022	1,011
1995	1,027	1,106	1,027	1,025	1,027	1,021	1,011
1996	1,027	1,109	1,027	1,024	1,027	1,022	1,011
1997	1,026	1,107	1,027	1,019	1,026	1,023	1,011
1998	1,031	1,110	1,033	1,022	1,031	1,023	1,011
1999	1,027	1,111	1,028	1,019	1,027	1,022	1,006
2000 ^a	1,027	1,111	1,028	1,019	1,027	1,022	1,006
2001 ^a	1,027	1,111	1,028	1,019	1,027	1,022	1,006

^a Preliminary.

Source: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A5. Approximate Heat Content of Coal and Coal Coke
(Million Btu per Short Ton)

	Coal									Coal Coke
	Production	Consumption						Imports	Exports	Imports and Exports
		End-Use Sectors			Electric Power Sector		Total			
		Residential and Commercial	Industrial		Electric Utilities	Other Power Producers ^b				
			Coke Plants	Other ^a						
1973	23.376	22.831	26.780	22.586	22.246	NA	23.057	25.000	26.596	24.800
1974	23.072	22.479	26.778	22.419	21.781	NA	22.677	25.000	26.700	24.800
1975	22.897	22.261	26.782	22.436	21.642	NA	22.506	25.000	26.562	24.800
1976	22.855	22.774	26.781	22.530	21.679	NA	22.498	25.000	26.601	24.800
1977	22.597	22.919	26.787	22.322	21.508	NA	22.265	25.000	26.548	24.800
1978	22.248	22.466	26.789	22.207	21.275	NA	22.017	25.000	26.478	24.800
1979	22.454	22.242	26.788	22.452	21.364	NA	22.100	25.000	26.548	24.800
1980	22.415	22.543	26.790	22.690	21.295	NA	21.947	25.000	26.384	24.800
1981	22.308	22.474	26.794	22.585	21.085	NA	21.713	25.000	26.160	24.800
1982	22.239	22.695	26.797	22.712	21.194	NA	21.674	25.000	26.223	24.800
1983	22.052	22.775	26.798	22.691	21.133	NA	21.576	25.000	26.291	24.800
1984	22.010	22.844	26.799	22.543	21.101	NA	21.573	25.000	26.402	24.800
1985	21.870	22.646	26.798	22.020	20.959	NA	21.366	25.000	26.307	24.800
1986	21.913	22.947	26.798	22.198	21.084	NA	21.462	25.000	26.292	24.800
1987	21.922	23.404	26.799	22.381	21.136	NA	21.517	25.000	26.291	24.800
1988	21.823	23.571	26.799	22.360	20.900	NA	21.328	25.000	26.299	24.800
1989	21.765	23.650	26.800	22.347	20.848	21.474	21.268	25.000	26.160	24.800
1990	21.822	23.137	26.799	22.457	20.929	20.539	21.324	25.000	26.202	24.800
1991	21.681	23.114	26.799	22.460	20.755	19.933	21.131	25.000	26.188	24.800
1992	21.682	23.105	26.799	22.250	20.787	18.983	21.107	25.000	26.161	24.800
1993	21.418	22.994	26.800	22.123	20.639	19.040	20.947	25.000	26.335	24.800
1994	21.394	23.112	26.800	22.068	20.673	19.485	20.979	25.000	26.329	24.800
1995	21.326	23.118	26.800	21.950	20.495	19.471	20.815	25.000	26.180	24.800
1996	21.322	23.011	26.800	22.105	20.525	19.427	20.826	25.000	26.174	24.800
1997	21.296	22.494	26.800	22.172	20.548	19.596	20.836	25.000	26.251	24.800
1998	21.418	22.620	27.426	23.164	20.513	20.143	20.868	25.000	26.800	24.800
1999	21.070	23.880	27.426	22.489	20.401	20.718	20.753	25.000	26.081	24.800
2000 ^c	21.072	23.880	27.426	22.489	20.401	20.718	20.753	25.000	26.117	24.800
2001 ^c	21.072	23.880	27.426	22.489	20.401	20.718	20.753	25.000	26.117	24.800

^a Includes transportation.

^b Nonutility wholesale producers of electricity, and nonutility cogeneration plants that are not included in the end-use sectors.

^c Preliminary.

Source: See "Thermal Conversion Factor Source Documentation," which follows Table A6.

Table A6. Approximate Heat Rates for Electricity
(Btu per Kilowatthour)

	Electricity Net Generation			Electricity Consumption
	Fossil-Fueled Steam-Electric Plants ^a	Nuclear Steam-Electric Plants	Geothermal Energy Plants ^b	
1973	10,389	10,903	21,674	3,412
1974	10,442	11,161	21,674	3,412
1975	10,406	11,013	21,611	3,412
1976	10,373	11,047	21,611	3,412
1977	10,435	10,769	21,611	3,412
1978	10,361	10,941	21,611	3,412
1979	10,353	10,879	21,545	3,412
1980	10,388	10,908	21,639	3,412
1981	10,453	11,030	21,639	3,412
1982	10,454	11,073	21,629	3,412
1983	10,520	10,905	21,290	3,412
1984	10,440	10,843	21,303	3,412
1985	10,447	10,813	21,263	3,412
1986	10,446	10,799	21,263	3,412
1987	10,419	10,776	21,263	3,412
1988	10,324	10,743	21,096	3,412
1989	10,432	10,724	21,096	3,412
1990	10,402	10,680	21,096	3,412
1991	10,436	10,740	20,997	3,412
1992	10,342	10,678	20,914	3,412
1993	10,309	10,682	20,914	3,412
1994	10,316	10,676	20,914	3,412
1995	10,312	10,658	20,914	3,412
1996	10,340	10,623	20,960	3,412
1997	10,357	10,623	20,960	3,412
1998	10,346	10,623	21,017	3,412
1999	10,346	10,623	21,017	3,412
2000 ^c	10,346	10,623	21,017	3,412
2001 ^c	10,346	10,623	21,017	3,412

^a Used as the thermal conversion factor for hydroelectric power generation, and for wood and waste, wind, photovoltaic, and solar thermal energy consumed at electric utilities.

^b Used as the thermal conversion factor for geothermal energy consumed at electric utilities.

^c Preliminary.

Source: See "Thermal Conversion Factor Source Documentation," which follows this table.

Thermal Conversion Factor Source Documentation

Approximate Heat Content of Petroleum and Natural Gas Plant Liquids

Asphalt. The Energy Information Administration (EIA) adopted the thermal conversion factor of 6.636 million British thermal units (Btu) per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.

Aviation Gasoline. EIA adopted the Bureau of Mines thermal conversion factor of 5.048 million Btu per barrel for "Gasoline, Aviation" as published by the Texas Eastern Transmission Corporation in Appendix V of *Competition and Growth in American Energy Markets 1947-1985*, a 1968 release of historical and projected statistics.

Butane. EIA adopted the Bureau of Mines thermal conversion factor of 4.326 million Btu per barrel in the *California Oil World and Petroleum Industry*, First Issue, April 1942.

Butane-Propane Mixture. EIA adopted the Bureau of Mines calculation of 4.130 million Btu per barrel based on an assumed mixture of 60 percent butane and 40 percent propane. See **Butane** and **Propane**.

Crude Oil, Exports. Assumed by EIA to be 5.800 million Btu per barrel or equal to the thermal conversion factor for crude oil produced in the United States. See **Crude Oil and Lease Condensate, Production**.

Crude Oil, Imports. Calculated annually by EIA by weighting the thermal conversion factor of each type of crude oil imported by the quantity imported. Thermal conversion factors for each type were calculated on a foreign country basis through 1996, by determining the average American Petroleum Institute (API) gravity of crude imported from each foreign country from Form ERA-60 in 1977, or for 1997 and later, by determining the weighted average API gravity from the Form EIA-814, and converting average API gravity to average Btu content by using National Bureau of Standards, Miscellaneous Publication No. 97, *Thermal Properties of Petroleum Products*, 1933.

Crude Oil and Lease Condensate, Production. EIA adopted the thermal conversion factor of 5.800 million Btu per barrel as reported in a Bureau of Mines internal memorandum, "Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950."

Crude Oil and Petroleum Products, Exports. Calculated annually by EIA as the average of the thermal conversion factors for each petroleum product exported and crude oil exported weighted by the quantity of each petroleum product and crude oil exported. See **Crude Oil, Exports** and **Petroleum Products, Exports**.

Crude Oil and Petroleum Products, Imports. Calculated annually by EIA as the average of the thermal conversion factors for each petroleum product and each type of crude oil imported weighted by the quantity of each petroleum product and each type of crude oil imported. See **Crude Oil, Imports** and **Petroleum Products, Imports**.

Distillate Fuel Oil. EIA adopted the Bureau of Mines thermal conversion factor of 5.825 million Btu per barrel as reported in a Bureau of Mines internal memorandum, "Bureau of Mines Standard Average Heating Value of Various Fuels, Adopted January 3, 1950."

Ethane. EIA adopted the Bureau of Mines thermal conversion factor of 3.082 million Btu per barrel in the *California Oil World and Petroleum Industry*, First Issue, April 1942.

Ethane-Propane Mixture. EIA calculated 3.308 million Btu per barrel based on an assumed mixture of 70 percent ethane and 30 percent propane. See **Ethane** and **Propane**.

Fuel Ethanol Blended Into Motor Gasoline. EIA adopted the thermal conversion factor of 3.539 million Btu per barrel published in "Oxygenate Flexibility for Future Fuels," a paper presented by William J. Piel of the ARCO Chemical Company at the National Conference on Reformulated Gasolines and Clean Air Act Implementation, Washington, D.C., October 1991.

Isobutane. EIA adopted the Bureau of Mines thermal conversion factor of 3.974 million Btu per barrel in the *California Oil World and Petroleum Industry*, First Issue, April 1942.

Jet Fuel, Kerosene Type. EIA adopted the Bureau of Mines thermal conversion factor of 5.670 million Btu per barrel for "Jet Fuel, Commercial" as published by the Texas Eastern Transmission Corporation in Appendix V of *Competition and Growth in American Energy Markets 1947-1985*, a 1968 release of historical and projected statistics.

Jet Fuel, Naphtha Type. EIA adopted the Bureau of Mines thermal conversion factor of 5.355 million Btu per barrel for "Jet Fuel, Military" as published by the Texas Eastern Transmission Corporation in Appendix V of *Competition and Growth in American Energy Markets 1947-1985*, a 1968 release of historical and projected statistics.

Kerosene. EIA adopted the Bureau of Mines thermal conversion factor of 5.670 million Btu per barrel as reported in a Bureau of Mines internal memorandum, "Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950."

Liquefied Petroleum Gases. • 1960 through 1966: U.S. Department of the Interior, Bureau of Mines, Mineral Industry Surveys, *Crude Petroleum and Petroleum Products, 1956*, Table 4 footnote, constant value of 4.011 million Btu per barrel. • 1967 forward: Calculated annually by EIA as a weighted average by multiplying the quantity consumed of each of the component products by each product's conversion factor, listed in this appendix, and dividing the sum of those heat contents by the sum of the quantities consumed.

The component products are ethane (including ethylene), propane (including propylene), normal butane (including butylene), butane-propane mixtures, ethane-propane mixtures, and isobutane. Quantities consumed are from: 1967 through 1980: EIA, Energy Data Reports, *Petroleum Statement, Annual*, Table 1. 1981 forward: EIA, *Petroleum Supply Annual*, Table 2.

Lubricants. EIA adopted the thermal conversion factor of 6.065 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual*, 1956.

Miscellaneous Products. EIA adopted the thermal conversion factor of 5.796 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual*, 1956.

Motor Gasoline. • 1960 through 1993: EIA adopted the Bureau of Mines thermal conversion factor of 5.253 million Btu per barrel for "Gasoline, Motor Fuel" as published by the Texas Eastern Transmission Corporation in Appendix V of Competition and Growth in American Energy Markets 1947-1985, a 1968 release of historical and projected statistics. • 1994 forward: EIA calculated national annual quantity-weighted average conversion factors for conventional, reformulated, and oxygenated motor gasolines (shown in appendix Table C1). The factor for conventional motor gasoline is 5.253 million Btu per barrel, as used for previous years. The factors for reformulated and oxygenated gasolines, both currently 5.150 million Btu per barrel, are based on data published in the Environmental Protection Agency, Office of Mobile Sources, National Vehicle and Fuel Emissions Laboratory report EPA 420-F-95-003, Fuel Economy Impact Analysis of Reformulated Gasoline.

Natural Gas Plant Liquids, Production. Calculated annually by EIA as the average of the thermal conversion factors of each natural gas plant liquid produced weighted by the quantity of each natural gas plant liquid produced.

Natural Gasoline. EIA adopted the thermal conversion factor of 4.620 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual*, 1956.

Pentanes Plus. EIA assumed the thermal conversion factor to be 4.620 million Btu per barrel or equal to that for natural gasoline. See **Natural Gasoline**.

Petrochemical Feedstocks, Naphtha Less Than 401 Degrees Fahrenheit. Assumed by EIA to be 5.248 million Btu per barrel, equal to the thermal conversion factor for special naphthas. See **Special Naphthas**.

Petrochemical Feedstocks, Oils Equal to or Greater Than 401 Degrees Fahrenheit. Assumed by EIA to be 5.825 million Btu per barrel, equal to the thermal conversion factor for distillate fuel oil. See **Distillate Fuel Oil**.

Petrochemical Feedstocks, Still Gas. Assumed by EIA to be 6.000 million Btu per barrel, equal to the thermal conversion factor for still gas. See **Still Gas**.

Petroleum Coke. EIA adopted the thermal conversion factor of 6.024 million Btu per barrel as reported in Btu per short ton in the Bureau of Mines internal memorandum, "Bureau of Mines Standard Average Heating Value of Various Fuels, Adopted January 3, 1950." The Bureau of Mines calculated this factor by dividing 30.120 million Btu per short ton, as given in the referenced Bureau of Mines internal memorandum, by 5.0 barrels per short ton, as given in the Bureau of Mines Form 6-1300-M and successor EIA forms.

Petroleum Products, Total Consumption. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed, weighted by the quantity of each petroleum product consumed.

Petroleum Products, Consumption by Electric Utilities. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed at electric utilities, weighted by the quantity of each petroleum product consumed at electric utilities. The quantity of petroleum consumed is estimated in the State Energy Data System as documented in the *State Energy Data Report*.

Petroleum Products, Consumption by Industrial Users. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed in the industrial sector, weighted by the estimated quantity of each petroleum product consumed in the industrial sector. The quantity of petroleum products consumed is estimated in the State Energy Data System as documented in the *State Energy Data Report*.

Petroleum Products, Consumption by Residential and Commercial Users. Calculated annually by EIA as the average of the thermal conversion factors for all petroleum products consumed by the residential and commercial sector, weighted by the estimated quantity of each petroleum product consumed in the residential and commercial sector. The quantity of petroleum products consumed is estimated in the State Energy Data System as documented in the *State Energy Data Report*.

Petroleum Products, Consumption by Transportation Users. Calculated annually by EIA as the average of the thermal conversion factor for all petroleum products consumed in the transportation sector, weighted by the estimated quantity of each petroleum product consumed in the transportation sector. The quantity of petroleum products consumed is estimated in the State Energy Data System as documented in the *State Energy Data Report*.

Petroleum Products, Exports. Calculated annually by EIA as the average of the thermal conversion factors for each petroleum product, weighted by the quantity of each petroleum product exported.

Petroleum Products, Imports. Calculated annually by EIA as the average of the thermal conversion factors for each petroleum product imported, weighted by the quantity of each petroleum product imported.

Plant Condensate. Estimated to be 5.418 million Btu per barrel by EIA from data provided by McClanahan Consultants, Inc., Houston, Texas.

Propane. EIA adopted the Bureau of Mines thermal conversion factor of 3.836 million Btu per barrel in the *California Oil World and Petroleum Industry*, First Issue, April 1942.

Residual Fuel Oil. EIA adopted the thermal conversion factor of 6.287 million Btu per barrel as reported in the Bureau of Mines internal memorandum, "Bureau of Mines Standard Average Heating Values of Various Fuels, Adopted January 3, 1950."

Road Oil. EIA adopted the Bureau of Mines thermal conversion factor of 6.636 million Btu per barrel, which was assumed to be equal to that of asphalt (see **Asphalt**) and was first published by the Bureau of Mines in the *Petroleum Statement, Annual, 1970*.

Special Naphthas. EIA adopted the Bureau of Mines thermal conversion factor of 5.248 million Btu per barrel, which was assumed to be equal to that of total gasoline (aviation and motor) factor and was first published in the *Petroleum Statement, Annual, 1970*.

Still Gas. EIA adopted the Bureau of Mines estimated thermal conversion factor of 6.000 million Btu per barrel and first published in the *Petroleum Statement, Annual, 1970*.

Unfinished Oils. EIA assumed the thermal conversion factor to be 5.825 million Btu per barrel or equal to that for distillate fuel oil (see **Distillate Fuel Oil**) and first published in the *Annual Report to Congress, Volume 3, 1977*.

Unfractionated Stream. EIA assumed the thermal conversion factor to be 5.418 million Btu per barrel or equal to that for plant condensate (see **Plant Condensate**) and first published in the *Annual Report to Congress, Volume 2, 1981*.

Waxes. EIA adopted the thermal conversion factor of 5.537 million Btu per barrel as estimated by the Bureau of Mines and first published in the *Petroleum Statement, Annual, 1956*.

Approximate Heat Content of Natural Gas

Natural Gas, Total Consumption. 1973-1979: EIA adopted the thermal conversion factor calculated annually by the American Gas Association (AGA) and published in *Gas Facts*, an AGA annual publication. 1980 forward: Calculated annually by EIA by dividing the total heat content of natural gas consumed by the total quantity of natural gas consumed. The heat content and quantity consumed are from Form EIA-176. Published sources are: 1980-1989: EIA, *Natural Gas Annual 1992, Volume 2, Table 15*. 1990-1992: EIA, *Natural Gas Annual 1992, Volume 2, Table 16*. 1993 forward: 1992 value used as an estimate.

Natural Gas, Consumption by Electric Utilities. Calculated annually by EIA by dividing the total heat content of natural gas received at electric utilities by the total quantity received at electric utilities. The heat contents and receipts are from Form FERC-423 and predecessor forms.

Natural Gas, Consumption by Sectors Other Than Electric Utilities. Calculated annually by EIA by dividing the heat content of all natural gas consumed less the heat content of natural gas consumed at electric utilities by the quantity of all natural gas consumed less the quantity of natural gas consumed at electric utilities. Data are from Forms EIA-176, FERC-423, EIA-759, and predecessor forms.

Natural Gas, Exports. Calculated annually by EIA by dividing the heat content of exported natural gas by the quantity of natural gas exported, both reported on Form FPC-14.

Natural Gas, Imports. Calculated annually by EIA by dividing the heat content of imported natural gas by the quantity of natural gas imported, both reported on Form FPC-14.

Natural Gas Production, Dry. Assumed by EIA to be equal to the thermal conversion factor for the consumption of dry natural gas. See **Natural Gas Total Consumption**.

Natural Gas Production, Marketed (Wet). Calculated annually by EIA by adding the heat content of dry natural gas production and the total heat content of natural gas plant liquids production and dividing this sum by the total quantity of marketed (wet) natural gas production.

Approximate Heat Content of Coal and Coal Coke

Coal, Total Consumption. Calculated annually by EIA by dividing the sum of the heat content of coal (including anthracite culm and waste coal) consumption by the total tonnage.

Coal, Consumption by Electric Utilities. Calculated annually by EIA by dividing the sum of the heat content of coal (including anthracite culm and waste coal) received at electric utilities by the sum of the tonnage received.

Coal, Consumption by Other Power Producers. Calculated annually by dividing the total heat content of coal (including anthracite culm and waste coal) consumed by other power producers by their total consumption tonnage.

Coal, Consumption by the Electric Power Sector. Calculated annually by dividing the total heat content of coal (including anthracite culm and waste coal) by total consumption tonnage of the electric power sector.

Coal, Consumption by End-Use Sectors. Calculated annually by EIA by dividing the sum of the heat content of coal (including anthracite culm and waste coal) consumed by the end-use sectors by the sum of the total tonnage.

Coal, Exports. Calculated annually by EIA by dividing the sum of the heat content of coal exported by the sum of the total tonnage.

Coal, Imports. Calculated annually by EIA by dividing the sum of the heat content of coal imported by the sum of the total tonnage.

Coal, Production. Calculated annually by EIA by dividing the sum of the total heat content of coal (including some anthracite culm) produced by the sum of the total tonnage.

Coal Coke, Imports and Exports. EIA adopted the Bureau of Mines estimate of 24.800 million Btu per short ton.

Approximate Heat Rates for Electricity

Fossil-Fueled Steam-Electric Plant Generation.

There is no generally accepted practice for measuring the thermal conversion rates for power plants that generate electricity from hydroelectric, wood and waste, wind, photovoltaic, or solar thermal energy sources. Therefore, EIA uses data from Form EIA-767 to calculate a rate factor that is equal to the prevailing annual average heat rate factor for fossil-fueled steam-electric power plants in the United States. By using that factor, it is possible to evaluate fossil fuel requirements for replacing those sources during periods of interruption such as droughts. The heat content of a kilowatthour of electricity produced, regardless of the generation process, is 3,412 Btu per kilowatthour. 1973-1991: The weighted annual average heat rate for fossil-fueled steam-electric power plants in the United States, as published by EIA in *Electric Plant Cost and Power*

Production Expenses 1991, Table 9. 1992 forward: Unpublished factors calculated on the basis of data from Form EIA-767.

Geothermal Energy Plant Generation.

1973-1981: Calculated annually by EIA by weighting the annual average heat rates of operating geothermal units by the installed nameplate capacities as reported on Form FPC-12. 1982 forward: Estimated annually by EIA on the basis of an informal survey of relevant plants.

Nuclear Steam-Electric Plant Generation.

1973-1991: Calculated annually by EIA by dividing the total heat content consumed in nuclear generating units by the total (net) electricity generated by nuclear generating units. The heat content and electricity generation are reported on Form FERC-1, "Annual Report of Major Electric Utilities, Licenses, and Others"; Form EIA-412, "Annual Report of Public Electric Utilities"; and predecessor forms. The factors, beginning with 1982 data, are published in the following EIA reports—1982: *Historical Plant Cost and Annual Production Expenses for Selected Electric Plants 1982*, page 215. 1983-1991: *Electric Plant Cost and Power Production Expenses 1991*, Table 13. 1992 forward: Calculated annually by EIA by dividing the total heat content of the steam leaving the nuclear generating units to generate electricity by the total (net) electricity generated by nuclear generating units. The heat content and electricity generation data are reported in Nuclear Regulatory Commission, *Licensed Operating Reactors—Status Summary Report*.

Appendix B. Metric and Other Physical Conversion Factors

Data presented in the *Monthly Energy Review* and in other Energy Information Administration publications are expressed predominately in units that historically have been used in the United States, such as British thermal units, barrels, cubic feet, and short tons. However, because U.S. commerce involves other nations, most of which use metric units of measure, the U.S. Government is committed to the transition to the metric system, as stated in the Metric Conversion Act of 1975 (Public Law 94-168), amended by the Omnibus Trade and Competitiveness Act of 1988 (Public Law 100-418), and Executive Order 12770 of July 25, 1991.

The metric conversion factors presented in Table B1 can be used to calculate the metric-unit equivalents of values expressed in U.S. customary units. For example, 500 short tons are the equivalent of 453.6 metric

tons (500 short tons x 0.9071847 metric tons/short ton = 453.6 metric tons).

In the metric system of weights and measures, the names of multiples and subdivisions of any unit may be derived by combining the name of the unit with prefixes, such as deka, hecto, and kilo, meaning, respectively, 10, 100, 1,000, and deci, centi, and milli, meaning, respectively, one-tenth, one-hundredth, and one-thousandth. Common metric prefixes can be found in Table B2.

The conversion factors presented in Table B3 can be used to calculate equivalents in various physical units commonly used in energy analyses. For example, 10 barrels are the equivalent of 420 U.S. gallons (10 barrels x 42 gallons/barrel = 420 gallons).

Table B1. Metric Conversion Factors

Type of Unit	U.S. Unit	multiplied by	Conversion Factor	equals	Metric Unit
Mass	short tons (2,000 lb)	x	0.907 184 7	=	metric tons (t)
	long tons	x	1.016 047	=	metric tons (t)
	pounds (lb)	x	.453 592 37 ^a	=	kilograms (kg)
	pounds uranium oxide (lb U ₃ O ₈)	x	0.384 647 ^b	=	kilograms uranium (kgU)
	ounces, avoirdupois (avdp oz)	x	28.349 52	=	grams (g)
Volume	barrels of oil (bbl)	x	0.158 987 3	=	cubic meters (m ³)
	cubic yards (yd ³)	x	0.764 555	=	cubic meters (m ³)
	cubic feet (ft ³)	x	0.028 316 85	=	cubic meters (m ³)
	U.S. gallons (gal)	x	3.785 412	=	liters (L)
	ounces, fluid (fl oz)	x	29.573 53	=	milliliters (mL)
	cubic inches (in ³)	x	16.387 06	=	milliliters (mL)
Length	miles (mi)	x	1.609 344 ^a	=	kilometers (km)
	yards (yd)	x	0.914 4 ^a	=	meters (m)
	feet (ft)	x	0.304 8 ^a	=	meters (m)
	inches (in)	x	2.54 ^b	=	centimeters (cm)
Area	acres	x	0.404 69	=	hectares (ha)
	square miles (mi ²)	x	2.589 988	=	square kilometers (km ²)
	square yards (yd ²)	x	0.836 127 4	=	square meters (m ²)
	square feet (ft ²)	x	0.092 903 04 ^a	=	square meters (m ²)
	square inches (in ²)	x	6.451 6 ^b	=	square centimeters (cm ²)
Temperature	degrees Fahrenheit (°F)	x	5/9 (after subtracting 32) ^{a,c}	=	degrees Celsius (°C)
Energy	British thermal units (Btu)	x	1,055.055 852 62 ^{a,d}	=	joules (J)
	calories (cal)	x	4.186 8 ^a	=	joules (J)
	Kilowatthours (kWh)	x	3.6 ^a	=	megajoules (MJ)

^aExact conversion.

^bCalculated by the Energy Information Administration.

^cTo convert degrees Celsius (°C) to degrees Fahrenheit (°F) exactly, multiply by 9/5, then add 32.

^dThe Btu used in this table is the International Table Btu adopted by the Fifth International Conference on Properties of Steam, London, 1956.
 Notes: • Spaces have been inserted after every third digit to the right of the decimal for ease of reading. • Most metric units belong to the International System of Units (SI), and the liter, hectare, and metric ton are accepted for use with the SI units. For more information about the SI units, contact Dr. Barry Taylor at Building 221, Room B610, National Institute of Standards and Technology, Gaithersburg, MD 20899, or on telephone number 301-975-4220.

Sources: • General Services Administration, Federal Standard 376B, *Preferred Metric Units for General Use by the Federal Government* (Washington, DC, January 27, 1993), pp. 9-11, 13, and 16. • National Institute of Standards and Technology, Special Publications 330, 811, and 814. • American National Standards Institute/Institute of Electrical and Electronic Engineers, ANSI/IEEE Std 268-1992, pp. 28 and 29.

Table B2. Metric Prefixes

Unit Multiple	Prefix	Symbol	Unit Subdivision	Prefix	Symbol
10 ¹	deka	da	10 ⁻¹	deci	d
10 ²	hecto	h	10 ⁻²	centi	c
10 ³	kilo	k	10 ⁻³	milli	m
10 ⁶	mega	M	10 ⁻⁶	micro	
10 ⁹	giga	G	10 ⁻⁹	nano	n
10 ¹²	tera	T	10 ⁻¹²	pico	p
10 ¹⁵	peta	P	10 ⁻¹⁵	femto	f
10 ¹⁸	exa	E	10 ⁻¹⁸	atto	a
10 ²¹	zetta	Z	10 ⁻²¹	zepto	z
10 ²⁴	yotta	Y	10 ⁻²⁴	yocto	y

Source: U.S. Department of Commerce, National Institute of Standards and Technology, *The International System of Units (SI)*, NIST Special Publication 330, 1991 Edition (Washington, DC, August 1991), p.10.

Table B3. Other Physical Conversion Factors

Energy Source	Original Unit	<i>multiplied by</i>	Conversion Factor	<i>equals</i>	Final Unit
Petroleum	barrels (bbl)	x	42 ^a	=	U.S. gallons (gal)
Coal	short tons	x	2,000 ^a	=	pounds (lb)
	long tons	x	2,240 ^a	=	pounds (lb)
	metric tons (t)	x	1,000 ^a	=	kilograms (kg)
Wood	cords (cd)	x	1.25 ^b	=	shorts tons
	cords (cd)	x	128 ^a	=	cubic feet (ft ³)

^aExact conversion.

^bCalculated by the Energy Information Administration.

Source: U.S. Department of Commerce, National Institute of Standards and Technology, *Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices*, NIST Handbook 44, 1994 Edition (Washington, DC, October 1993), pp. B-10, C-17 and C-21.

Appendix C. Carbon Dioxide Emission Factors for Coal

Table C1 presents U.S. average carbon dioxide emission factors for coal by sector. The factors measure the emissions produced during the combustion of coal and were derived by the Energy Information Administration (EIA) from 5,426 sample analyses in EIA's Coal Analysis File. The factors are ratios of the carbon

dioxide emitted to the heat content of the coal burned, assuming complete combustion. Factors vary according to the rank and geographic origin of the coal. Sectoral factors reflect the rank and origin of the coal consumed in the sector.

Table C1. Average Carbon Dioxide Emission Factors for Coal by Sector
(Pounds of Carbon Dioxide per Million Btu)

Year	Residential and Commercial	Industrial		Electric Utilities	U.S. Average ^b
		Coke Plants ^a	Other Coal		
1980	210.6	205.8	205.9	206.7	206.5
1981	212.0	205.8	205.9	206.9	206.7
1982	210.4	205.7	206.0	207.0	206.9
1983	209.2	205.5	205.9	207.1	207.0
1984	209.5	205.6	206.2	207.1	207.0
1985	209.3	205.6	206.4	207.3	207.1
1986	209.2	205.4	206.5	207.3	207.1
1987	209.4	205.2	206.4	207.3	207.2
1988	209.1	205.3	206.4	207.6	207.3
1989	209.7	205.3	206.6	207.5	207.3
1990	209.5	206.2	206.8	207.6	207.4
1991	210.2	206.2	206.9	207.7	207.5
1992	211.2	206.2	207.1	207.7	207.6
1993	209.9	206.2	207.0	207.8	207.7
1994	209.8	206.3	207.2	207.9	207.8
1995	210.2	206.4	207.2	208.1	207.9
1996	209.5	206.5	207.0	208.1	208.0
1997	210.2	206.6	207.2	208.2	208.0
1998	209.7	206.7	206.9	204.4	206.9
1999	208.8	206.7	207.0	204.6	204.8

^aNo allowances have been made for carbon retained in non-energy coal chemical byproducts from the carbonization process.

^bWeighted average. The weights used are consumption values by sector.

Source: Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels.

Appendix D. List of Features

The following is a complete list of features that have appeared in the *Monthly Energy Review* since the first issue was published in October 1974. There are several categories of features on the list: “Energy Plugs” are 1-page descriptions of recently released EIA products. “Articles” cover a wide range of energy-related subjects in depth; “Highlights” summarize the most important information presented in the subject Energy

Information Administration (EIA) report; “Energy Previews” provide brief overviews of EIA preliminary energy data on a given topic; “EIA Data News” items present information on recent changes in the scope, design, methodology, and findings of EIA’s energy surveys and databases; and “Energy Snapshots” use graphics to set off key data from EIA survey reports.

Feature

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Energy Plug: <i>World Energy “Areas To Watch”</i>	August 2001
Energy Plug: <i>Electric Power Annual 2000, Volume I</i>	September 2001

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Energy Plug: <i>Inventory of Nonutility Electric Power Plants in the United States 1998</i>	January 2000
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Energy Plug: <i>Winter Fuels Outlook: 2000-2001</i>	October 2000
Energy Plug: <i>Advance Summary: U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 1999 Annual Report</i>	October 2000
Energy Plug: <i>Residential Natural Gas Prices: What Consumers Should Know</i>	November 2000
Energy Plug: <i>The Changing Structure of the Electric Power Industry 2000: An Update</i>	November 2000
Energy Plug: <i>Annual Energy Outlook 2001 Early Release</i>	December 2000
Energy Plug: <i>Residential Heating Oil Prices: What Consumers Should Know</i>	December 2000

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Energy Plug: <i>Performance Profiles of Major Energy Producers 1997</i>	January 1999
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Article: Measuring Dependence on Imported Oil	August 1995
Energy Preview: Household Energy Consumption and Expenditures 1993, Preliminary Estimates	August 1995
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Highlights: <i>State Energy Data Report 1993, Consumption Estimates</i>	October 1995
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Highlights: <i>Annual Energy Review 1994</i>	November 1995
Energy Preview: Alternative Fuel Providers Fleet Surveys, Preliminary Data	November 1995
Article: Environmental Externalities in Electric Power Markets: Acid Rain, Urban Ozone, and Climate Change	November 1995
Energy Preview: Alternative Fuel Providers Fleet Surveys, Preliminary Data	December 1995

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Energy Preview: Commercial Buildings Energy Consumption Survey, Preliminary Estimates, 1992	January 1994
Highlights: <i>Household Vehicles Energy Consumption 1991</i>	February 1994
Highlights: <i>Energy Use and Carbon Emissions: Some International Comparisons</i>	April 1994
Highlights: <i>Commercial Buildings Characteristics 1992</i>	June 1994
Article: Demand, Supply, and Price Outlook for Reformulated Motor Gasoline 1995	July 1994
Article: Commercial Nuclear Electric Power in the United States: Problems and Prospects	August 1994
Article: The Impact of Flow Control and Tax Reform on Ownership and Growth in the U.S.	August 1994
Highlights: <i>Reducing Home Heating and Cooling Costs</i>	September 1994
Energy Preview: Commercial Buildings Energy Consumption and Expenditures 1992, Preliminary Estimates	September 1994
Article: Carbon Dioxide Emission Factors for Coal: A Summary Waste-to-Energy Industry	September 1994
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Highlights: <i>Energy End-Use Intensities in Commercial Buildings</i>	October 1994
Article: Change in Method for Estimating Fuel Economy for the Residential Transportation Energy Consumption Survey	October 1994
Article: Comparability of Supply- and Consumption-Derived Estimates of Manufacturing Energy Consumption	October 1994
Energy Preview: Housing Characteristics 1993, Selected Preliminary Estimates	November 1994
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Energy Preview: Residential Transportation Energy Consumption Survey, Preliminary Estimates, 1991	January 1993
EIA Data News: Natural Gas Transported for the Account of Others	February 1993
Highlights: <i>Federal Energy Subsidies: Direct and Indirect Interventions in Energy Markets</i>	July 1993
Highlights: <i>Household Energy Consumption and Expenditures 1990</i>	August 1993
Article: Demand, Supply, and Price Outlook for Low-Sulfur Diesel Fuel	August 1993
Energy Preview: Manufacturing Energy Consumption Survey, Preliminary Estimates, 1991	September 1993
Highlights: <i>Natural Gas 1992: Issues and Trends</i>	September 1993
Highlights: <i>International Energy Outlook 1993</i>	October 1993
Highlights: <i>The Changing Structure of the U.S. Coal Industry: An Update</i>	November 1993
Highlights: <i>Emissions of Greenhouse Gases in the United States 1985-1990</i>	December 1993
Highlights: <i>Assessment of Energy Use in Multibuilding Facilities</i>	December 1993

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Energy Preview: Residential Energy Consumption and Expenditures Preliminary Estimates, 1990	April 1992
EIA Data News: Oxygenate Data Collection Begins	May 1992
Highlights: <i>Lighting in Commercial Buildings</i>	June 1992
Article: Demand, Supply, and Price Outlook for Oxygenated Gasoline, Winter 1992-1993	August 1992
EIA Data News: EIA Statistics on Electric Utility Demand-Side Management	September 1992
EIA Data News: EIA Statistics on Nonutility Power Producers	October 1992
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Highlights: *U.S. Oil and Gas Reserves by Year of Field Discovery* August 1990

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Article: A Review of Valdez Oil Spill Market Impacts March 1989
Article: Monthly U.S. Crude Oil Production Estimates March 1989
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Highlights: *Household Energy Consumption and Expenditures 1987, Part 1: National Data* November 1989
Article: Improved Energy Profits Offset by Refining Results in 1989 December 1989

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Article: Measures of Energy Consumption, Expenditures, and Prices May 1988
Article: The U.S. Energy Industry's Financial Recovery Continued in the First Half of 1988 June 1988
Article: A U.S. Perspective on Condensate June 1988
Highlights: *Characteristics of Commercial Buildings 1986* June 1988
Article: State Energy Severance Taxes, 1972-1987 July 1988
Highlights: *Manufacturing Energy Consumption Survey: Consumption of Energy, 1985* September 1988
Highlights: *Profiles of Foreign Direct Investment in U.S. Energy 1987* October 1988
Highlights: *Manufacturing Energy Consumption Survey: Fuel Switching, 1985* November 1988
Article: Increased Refining Income Led U.S. Energy Industry Financial Recovery in 1988 December 1988

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Article: Manufacturing Sector Energy Consumption, 1985 Provisional Estimates January 1987
Highlights: *Consumption and Expenditures, April 1984 Through March 1985,*
Part 1: National Data April 1987
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Article: U.S. Energy Industry Financial Developments, 1987 Second Quarter June 1987
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Article: U.S. Energy Industry Financial Developments, 1986 Second Quarter June 1986
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Article: U.S. Energy Industry Financial Developments, 1986 December 1986

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Highlights: *Annual Outlook for U.S. Electric Power 1985* June 1985
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Highlights: *State Energy Price and Expenditure Report, 1970-1981* May 1984
Highlights: *Solar Collector Manufacturing Activity 1983* June 1984

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Highlights: <i>International Energy Annual 1983</i>	September 1984
Highlights: <i>Estimates of U.S. Wood Energy Consumption, 1980-1983</i>	September 1984
Highlights: <i>Energy Conservation Indicators 1983 Annual Report</i>	November 1984
Highlights: <i>Annual Energy Outlook 1984</i>	December 1984

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Highlights: <i>Residential Energy Consumption Survey: Consumption and Expenditures</i>	January 1983
Highlights: <i>Residential Energy Consumption Survey: Housing Characteristics</i>	February 1983
Article: The Effect of Weather on Energy Use	April 1983
Article: Trends in U.S. Energy Since 1973	May 1983
Article: Data Series on Petroleum Use at Electric Utilities	July 1983
Highlights: <i>Energy Price and Expenditure Data Report, 1970-1980</i>	July 1983
Highlights: <i>Railroad Deregulation: Impact on Coal</i>	August 1983
Highlights: <i>Port Deepening and User Fees: Impact on U.S. Coal Exports</i>	August 1983
Highlights: <i>U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1982 Annual Report</i>	September 1983
Article: Residential Energy Consumption, 1978 Through 1981	September 1983
Article: Exploring for Oil and Gas	November 1983
Article: The Influence of Federal Actions on Petroleum Exploration	December 1983[2]
Article: Aggregate Statistics: Accurate or Misleading?	December 1983[3]

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Article: The Interstate and Intrastate Natural Gas Markets	January 1982
Article: Natural Gas Drilling and Production Under the Natural Gas Policy Act	February 1982
Highlights: <i>U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1981 Annual Report</i>	September 1982
Article: Impacts of Financial Constraints on the Electric Utility Industry	October 1982
Highlights: <i>Energy Company Development Patterns in the Postembargo Era</i>	November 1982

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Article: Changes in 1981 Petroleum Data Series	May 1981
Article: Information Services of the Energy Information Administration	September 1981
Article: An Overview of Natural Gas Markets	December 1981

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Article: The Solar Collector Industry and Solar Energy	February 1980
Article: Trends in the Installation of Energy Using Equipment in New Residential Buildings	March 1980
Article: The Energy Information Administration's Oil and Gas Reserves Program—The First Year's Report	June 1980
Article: Energy From Urban Waste	August 1980
Article: Natural Gas Liquids: Revisions to 1979 Data	October 1980
Article: EIA Weekly Petroleum Data: Data Collection and Methods of Estimation	November 1980
Article: The Department of Energy Disclosure Policy for Individually Identifiable Information Maintained by the Energy Information Administration	December 1980

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Article: The Energy Requirements of U.S. Agriculture	July 1979
Article: Three Mile Island—Possible Regulatory Responses and Their Impacts on the Nation's Short-Term Electric Utility Fuel Outlook	October 1979
Article: Reduction in Natural Gas Requirements Due to Fuel Switching	December 1979

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Article: Short-Term Petroleum Supply and Demand	May 1978
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Article: Crude Oil Entitlements Program	January 1977
Article: Motor Gasoline Supply and Demand	July 1977

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Article: Curtailments of Natural Gas Service	January 1976
Article: Home Heating Conservation Alternatives and the Solar Collector Industry	March 1976
Article: Trends in United States Petroleum Imports	September 1976

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Article: Energy Consumption	March 1975
Article: Nuclear Power	April 1975
Article: The Price of Crude Oil	June 1975
Article: U.S. Coal Resources and Reserves	July 1975
Article: Propane—A National Energy Resource	September 1975
Article: Short-Term Energy Supply and Demand Forecasting at FEA	October 1975

Appendix E. Renewable Energy

Beginning with the January 2001 issue of the *Monthly Energy Review (MER)*, previously uncounted portions of renewable energy data (including renewable nonutility generation and all nonelectric energy) were fully incorporated into the *MER* summaries in Sections 1 and 2. The addition of these data into the summaries raised the U.S. energy consumption total by 3 to 4 quadrillion Btu per year in recent years.

The tables presented in this appendix organize and summarize the renewable energy data and estimates that are now used in Sections 1 and 2 summary tables. Caution is warranted in using some of the monthly values; in particular, monthly data on Table E2 are not available from data collection systems but are estimated instead from daily rates of the annual data.

Table E1. Renewable Energy Consumption by Source
(Trillion Btu)

	Conventional Hydroelectric Power ^{a,b}	Wood ^c	Waste ^d	Alcohol Fuels ^e	Geothermal ^f	Solar ^g	Wind ^h	Total
1973 Total	3,010	1,527	2	NA	43	NA	NA	4,581
1974 Total	3,309	1,538	2	NA	53	NA	NA	4,902
1975 Total	3,219	1,497	2	NA	70	NA	NA	4,788
1976 Total	3,066	1,711	2	NA	78	NA	NA	4,857
1977 Total	2,515	1,837	2	NA	77	NA	NA	4,431
1978 Total	3,141	2,036	1	NA	64	NA	NA	5,243
1979 Total	3,141	2,150	2	NA	84	NA	NA	5,377
1980 Total	^E 3,118	2,483	2	NA	110	NA	NA	5,712
1981 Total	^E 3,105	2,495	88	7	123	NA	NA	5,818
1982 Total	^E 3,572	2,477	119	19	105	NA	NA	6,292
1983 Total	^E 3,899	2,639	157	35	129	NA	(s)	6,860
1984 Total	^E 3,800	2,629	208	43	165	(s)	(s)	6,845
1985 Total	^E 3,398	^E 2,576	^E 236	^E 52	198	(s)	(s)	6,460
1986 Total	^E 3,446	^E 2,518	^E 263	^E 60	219	(s)	(s)	6,507
1987 Total	^E 3,117	^E 2,465	289	69	229	(s)	(s)	6,170
1988 Total	^E 2,662	^E 2,552	^E 315	^E 70	217	(s)	(s)	5,817
1989 Total	3,014	^E 2,635	354	71	334	59	24	6,492
1990 Total	3,146	^E 2,188	408	63	355	63	32	6,254
1991 Total	3,159	^E 2,188	440	73	363	66	32	6,320
1992 Total	2,818	^E 2,288	473	83	374	67	30	6,134
1993 Total	3,119	2,226	479	97	387	71	31	6,410
1994 Total	2,993	2,314	515	109	391	72	36	6,429
1995 Total	3,481	2,418	531	117	333	73	33	6,987
1996 Total	3,892	2,465	577	84	346	75	35	7,473
1997 Total	3,961	2,348	551	106	322	74	33	7,395
1998 Total	3,569	2,326	533	117	328	74	31	6,977
1999 January	^E 306	^E 220	^E 49	11	^E 25	^E 6	2	619
February	^E 302	^E 196	^E 45	9	^E 22	^E 5	2	581
March	^E 337	^E 216	^E 48	10	^E 25	^E 6	3	643
April	^E 303	^E 210	^E 48	9	^E 24	^E 6	4	603
May	^E 317	^E 216	^E 49	9	^E 25	^E 6	6	628
June	^E 328	^E 209	^E 48	10	^E 29	^E 7	6	636
July	^E 320	^E 220	^E 49	8	^E 31	^E 7	6	641
August	^E 282	^E 219	^E 49	10	^E 32	^E 7	5	603
September	^E 243	^E 218	^E 47	10	^E 31	^E 6	4	558
October	^E 231	^E 217	^E 46	12	^E 32	^E 6	3	547
November	^E 243	^E 209	^E 47	12	^E 30	^E 6	2	549
December	^E 300	^E 216	^E 49	14	^E 30	^E 6	3	617
Total	3,512	2,566	^E 572	122	335	73	46	7,226
2000 January	^E 286	^E 220	^E 45	12	^E 27	^E 6	4	599
February	^E 257	^E 207	^E 43	9	^E 24	^E 5	4	549
March	^E 298	^E 220	^E 46	12	^E 24	^E 6	4	610
April	^E 315	^E 213	^E 44	10	^E 25	^E 6	5	618
May	^E 309	^E 217	^E 46	12	^E 26	^E 6	5	620
June	^E 286	^E 212	^E 45	7	^E 26	^E 6	4	586
July	^E 283	^E 222	^E 46	13	^E 27	^E 6	4	602
August	^E 265	^E 220	^E 46	12	^E 28	^E 6	4	581
September	^E 217	^E 213	^E 44	11	^E 27	^E 6	4	522
October	^E 196	^E 220	^E 46	13	^E 28	^E 6	5	514
November	^E 221	^E 213	^E 45	13	^E 28	^E 6	4	529
December	^E 217	^E 219	^E 45	14	^E 29	^E 6	4	534
Total	^E 3,149	^E 2,596	^E 541	139	^E 319	^E 70	51	6,865
2001 January	^E 210	^E 220	^E 45	15	^E 29	^E 5	^E 4	529
February	^E 194	^E 199	^E 44	12	^E 26	^E 5	^E 5	484
March	^E 229	^E 220	^E 45	12	^E 27	^E 6	^E 6	546
April	^E 208	^E 212	^E 47	11	^E 25	^E 6	7	516
May	^{RE} 225	^E 219	^E 48	11	^E 25	^E 6	^E 8	541
June	^{RE} 233	^E 214	^E 47	12	^E 25	^E 6	7	^R 544
July	^E 204	^E 224	^E 48	11	^E 27	^E 6	7	528
7-Month Total	^E 1,503	^E 1,508	^E 324	84	^E 184	^E 40	45	3,688
2000 7-Month Total	^E 2,033	^E 1,511	^E 315	75	^E 179	^E 41	31	4,185
1999 7-Month Total	^E 2,213	^E 1,487	^E 336	65	^E 181	^E 42	30	4,352

^a Hydroelectricity generated by pumped storage is not included in renewable energy.

^b Through 1988, includes all electricity net imports. From 1989, includes only the portion of electricity net imports derived from hydroelectric power.

^c Wood, wood waste, black liquor, red liquor, spent sulfite liquor, wood sludge, peat, railroad ties, and utility poles.

^d Municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed loop biomass, fish oil, and straw. For 1999 forward, data also include electricity net generation from batteries, chemicals, hydrogen, pitch, sulfur, and purchased steam.

^e Ethanol blended into motor gasoline.

^f Geothermal electricity net generation, heat pump, and direct use energy. From 1989, also includes electricity imports derived from geothermal energy.

^g Solar thermal and photovoltaic electricity net generation, and solar thermal direct use energy.

^h Wind electricity net generation.

R=Revised. NA=Not available. E=Estimate. (s)=Less than 0.5 trillion Btu.

Notes: Totals may not equal sum of components due to independent rounding. Geographic coverage is the 50 states and the District of Columbia.

Sources: Tables E2, E3a, and E3b.

Table E2. Renewable Energy Consumption by End-Use Sector
(Trillion Btu)

	Residential				Commercial			Industrial ^a				Trans- portation	End-Use Total
	Wood ^b	Geo- thermal ^c	Solar ^d	Total	Wood ^b	Geo- thermal ^c	Total	Wood ^e	Waste ^f	Geo- thermal ^c	Total	Alcohol Fuels ^g	
1973 Total	354	NA	NA	354	7	NA	7	1,165	NA	NA	1,165	NA	1,526
1974 Total	371	NA	NA	371	7	NA	7	1,159	NA	NA	1,159	NA	1,537
1975 Total	425	NA	NA	425	8	NA	8	1,063	NA	NA	1,063	NA	1,497
1976 Total	482	NA	NA	482	9	NA	9	1,220	NA	NA	1,220	NA	1,711
1977 Total	542	NA	NA	542	10	NA	10	1,281	NA	NA	1,281	NA	1,833
1978 Total	622	NA	NA	622	12	NA	12	1,400	NA	NA	1,400	NA	2,034
1979 Total	728	NA	NA	728	14	NA	14	1,405	NA	NA	1,405	NA	2,147
1980 Total	859	NA	NA	859	21	NA	21	1,600	NA	NA	1,600	NA	2,480
1981 Total	869	NA	NA	869	21	NA	21	1,602	87	NA	1,689	7	2,586
1982 Total	937	NA	NA	937	22	NA	22	1,516	118	NA	1,634	19	2,612
1983 Total	925	NA	NA	925	22	NA	22	1,690	155	NA	1,845	35	2,827
1984 Total	923	NA	NA	923	22	NA	22	1,679	204	NA	1,883	43	2,871
1985 Total	^I 899	NA	NA	^I 899	^I 24	NA	^I 24	^I 1,645	^I 230	NA	^E 1,875	^I 52	^I 2,850
1986 Total	^I 876	NA	NA	^I 876	^I 27	NA	^I 27	^I 1,610	^I 256	NA	^E 1,866	^I 60	^I 2,829
1987 Total	^I 852	NA	NA	^I 852	^I 29	NA	^I 29	^I 1,576	^I 282	NA	^E 1,858	^I 69	^I 2,808
1988 Total	^I 885	NA	NA	^I 885	^I 32	NA	^I 32	^I 1,625	^I 308	NA	^E 1,933	^I 70	^I 2,920
1989 Total	918	5	53	976	^I 34	3	^E 37	1,394	250	2	1,646	71	2,729
1990 Total	581	6	56	642	^I 37	3	^E 40	1,254	271	2	1,527	63	2,272
1991 Total	613	6	58	677	^I 39	3	^E 42	1,190	275	2	1,467	73	2,259
1992 Total	645	6	60	711	^I 42	3	^E 45	1,233	289	2	1,525	83	2,365
1993 Total	548	7	62	616	44	3	47	1,255	288	2	1,546	97	2,307
1994 Total	537	6	64	607	45	4	49	1,342	318	3	1,663	109	2,428
1995 Total	596	7	65	667	45	5	50	1,402	322	3	1,727	117	2,561
1996 Total	595	7	66	668	49	5	54	1,441	363	3	1,807	84	2,612
1997 Total	433	7	65	506	47	6	53	1,513	338	3	1,854	106	2,518
1998 Total	387	8	65	459	47	7	54	1,564	312	3	1,879	117	2,509
1999 January	^A 35	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 145	^A 25	^A (s)	^A 170	11	227
February	^A 32	^A 1	^A 5	^A 37	^A 4	^A 1	^A 4	^A 131	^A 22	^A (s)	^A 154	9	205
March	^A 35	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 145	^A 25	^A (s)	^A 170	10	226
April	^A 34	^A 1	^A 5	^A 40	^A 4	^A 1	^A 5	^A 141	^A 24	^A (s)	^A 165	9	218
May	^A 35	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 145	^A 25	^A (s)	^A 170	9	226
June	^A 34	^A 1	^A 5	^A 40	^A 4	^A 1	^A 5	^A 141	^A 24	^A (s)	^A 165	10	219
July	^A 35	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 145	^A 25	^A (s)	^A 170	8	225
August	^A 35	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 145	^A 25	^A (s)	^A 170	10	226
September	^A 34	^A 1	^A 5	^A 40	^A 4	^A 1	^A 5	^A 141	^A 24	^A (s)	^A 165	10	219
October	^A 35	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 145	^A 25	^A (s)	^A 170	12	229
November	^A 34	^A 1	^A 5	^A 40	^A 4	^A 1	^A 5	^A 141	^A 24	^A (s)	^A 165	12	222
December	^A 35	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 145	^A 25	^A (s)	^A 170	14	230
Total	414	8	64	486	51	7	58	1,711	291	4	2,007	122	2,673
2000 January	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 144	^A 24	^A (s)	^A 169	12	228
February	^A 34	^A 1	^A 5	^A 40	^A 4	^A 1	^A 5	^A 135	^A 23	^A (s)	^A 158	9	212
March	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 144	^A 24	^A (s)	^A 169	12	228
April	^A 36	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 139	^A 23	^A (s)	^A 163	10	220
May	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 144	^A 24	^A (s)	^A 169	12	228
June	^A 36	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 139	^A 23	^A (s)	^A 163	7	216
July	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 144	^A 24	^A (s)	^A 169	13	230
August	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 144	^A 24	^A (s)	^A 169	12	229
September	^A 36	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 139	^A 23	^A (s)	^A 163	11	221
October	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 144	^A 24	^A (s)	^A 169	13	230
November	^A 36	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 139	^A 23	^A (s)	^A 163	13	223
December	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 144	^A 24	^A (s)	^A 169	14	230
Total	^E 433	^E 9	^E 62	^E 503	^E 52	^E 8	^E 60	^E 1,702	^E 287	^E 4	^E 1,993	139	2,695
2001 January	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 145	^A 24	^A (s)	^A 169	15	232
February	^A 33	^A 1	^A 5	^A 39	^A 4	^A 1	^A 5	^A 131	^A 22	^A (s)	^A 153	12	208
March	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 145	^A 24	^A (s)	^A 169	12	229
April	^A 36	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 140	^A 24	^A (s)	^A 164	11	221
May	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 145	^A 24	^A (s)	^A 169	11	228
June	^A 36	^A 1	^A 5	^A 41	^A 4	^A 1	^A 5	^A 140	^A 24	^A (s)	^A 164	12	222
July	^A 37	^A 1	^A 5	^A 43	^A 4	^A 1	^A 5	^A 145	^A 24	^A (s)	^A 169	11	228
7-Month Total	^A 252	^A 5	^A 36	^A 292	^A 30	^A 4	^A 35	^A 988	^A 166	^A 3	^A 1,157	84	1,568
2000 7-Month Total	^A 252	^A 5	^A 36	^A 293	^A 30	^A 4	^A 35	^A 990	^A 167	^A 3	^A 1,160	75	1,562
1999 7-Month Total	^A 240	^A 5	^A 37	^A 282	^A 30	^A 4	^A 34	^A 994	^A 169	^A 2	^A 1,166	65	1,546

^a Through 1988, includes industrial sector use of wood and waste to produce both useful thermal output and electricity. From 1989, includes the portion of nonutility power producers' use of renewable energy to produce useful thermal output; excludes the portion used to produce electricity, which is included under "Nonutility Power Producers" on Table E3b.

^b Wood only.

^c Geothermal heat pump and direct use energy.

^d Solar thermal direct use and photovoltaic energy. Includes small amounts of commercial sector use.

^e Wood, wood waste, black liquor, red liquor, spent sulfite liquor, wood sludge, peat, railroad ties, and utility poles.

^f Municipal solid waste, landfill gas, methane, digester gas, liquid acetoneitrile

waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed loop biomass, fish oil, and straw.

^g Ethanol blended into motor gasoline.

NA=Not available. E=Estimate. (s)=Less than 0.5 trillion Btu. I=Interpolated value. A=Apportioned data: monthly estimates for 1999 and 2000 are created by dividing the annual value by the number of days in the year and then multiplying by the number of days in the month; temporary 2001 monthly estimates are created by dividing the 2000 annual value by 365 and multiplying by the number of days in the month.

Notes: Totals may not equal sum of components due to independent rounding. Geographic coverage is the 50 states and the District of Columbia.

Sources: See end of section.

Table E3a. Renewable Energy Consumption by the Electric Power Sector (Part 1 of 2)
(Trillion Btu)

	Electric Power Sector						
	Electric Utilities						Total
	Conventional Hydroelectric Power ^a	Wood ^b	Waste ^c	Geothermal ^d	Solar ^e	Wind ^f	
1973 Total	2,827	1	2	43	0	NA	2,873
1974 Total	3,143	1	2	53	0	NA	3,199
1975 Total	3,122	(s)	2	70	0	NA	3,194
1976 Total	2,943	1	2	78	0	NA	3,024
1977 Total	2,301	3	2	77	0	NA	2,383
1978 Total	2,905	2	1	64	0	NA	2,973
1979 Total	2,897	3	2	84	0	NA	2,986
1980 Total	2,867	3	2	110	0	NA	2,982
1981 Total	2,725	3	1	123	0	NA	2,852
1982 Total	3,233	2	1	105	0	NA	3,341
1983 Total	3,494	2	2	129	0	(s)	3,627
1984 Total	3,353	5	4	165	(s)	(s)	3,527
1985 Total	2,937	8	7	198	(s)	(s)	3,150
1986 Total	3,038	5	7	219	(s)	(s)	3,270
1987 Total	2,602	8	7	229	(s)	(s)	2,846
1988 Total	2,302	10	8	217	(s)	(s)	2,536
1989 Total	2,765	10	10	197	(s)	(s)	2,983
1990 Total	2,948	8	13	181	(s)	(s)	3,151
1991 Total	2,923	8	14	170	(s)	(s)	3,114
1992 Total	2,521	8	13	169	(s)	(s)	2,712
1993 Total	2,774	9	11	158	(s)	(s)	2,953
1994 Total	2,549	8	13	145	(s)	(s)	2,714
1995 Total	3,056	7	10	99	(s)	(s)	3,173
1996 Total	3,423	8	12	110	(s)	(s)	3,553
1997 Total	3,535	8	13	115	(s)	(s)	3,670
1998 Total	3,195	7	14	109	(s)	(s)	3,325
1999 January	287	1	1	9	(s)	(s)	297
February	279	1	1	7	(s)	(s)	288
March	312	(s)	1	8	(s)	(s)	321
April	265	1	1	9	(s)	(s)	276
May	282	1	1	(s)	(s)	(s)	284
June	297	1	1	(s)	(s)	(s)	299
July	288	1	1	(s)	(s)	(s)	290
August	250	1	1	(s)	(s)	(s)	252
September	203	1	1	(s)	(s)	(s)	205
October	193	(s)	1	(s)	(s)	(s)	195
November	206	1	1	(s)	(s)	(s)	208
December	242	1	1	(s)	(s)	(s)	244
Total	3,103	7	14	36	(s)	(s)	3,159
2000 January	241	(s)	1	(s)	(s)	(s)	243
February	214	1	1	(s)	(s)	(s)	216
March	254	1	1	(s)	(s)	(s)	256
April	271	1	1	(s)	(s)	(s)	273
May	261	1	1	(s)	(s)	(s)	263
June	239	1	1	(s)	(s)	(s)	241
July	229	1	1	(s)	(s)	(s)	231
August	209	1	1	(s)	(s)	(s)	211
September	169	1	1	(s)	(s)	(s)	171
October	163	1	1	(s)	(s)	(s)	166
November	182	1	1	(s)	(s)	(s)	184
December	187	1	1	(s)	(s)	(s)	189
Total	2,619	7	14	3	(s)	(s)	2,644
2001 January	176	1	1	(s)	(s)	(s)	179
February	166	1	1	(s)	(s)	(s)	168
March	193	1	1	(s)	(s)	(s)	195
April	165	1	1	(s)	(s)	(s)	167
May	179	(s)	2	(s)	(s)	(s)	181
June	193	(s)	2	(s)	(s)	(s)	195
July	170	1	1	(s)	(s)	(s)	172
7-Month Total	1,243	4	9	2	(s)	(s)	1,259
2000 7-Month Total	1,708	4	9	2	(s)	(s)	1,723
1999 7-Month Total	2,009	4	8	34	(s)	(s)	2,056

^a Through 1989, includes hydroelectricity generated by both conventional and pumped storage facilities; from 1990, includes only conventional hydroelectric generation.

^b Wood, wood waste, black liquor, red liquor, spent sulfite liquor, wood sludge, peat, railroad ties, and utility poles.

^c Municipal solid waste, landfill gas, methane, digester gas, liquid acetone/nitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed loop biomass, fish oil, and straw.

^d Geothermal electricity net generation.

^e Solar thermal and photovoltaic electricity net generation.

^f Wind electricity net generation.

NA=Not available. (s)=Less than 0.5 trillion Btu.

Notes: Totals may not equal sum of components due to independent rounding. Geographic coverage is the 50 states and the District of Columbia.

Sources: Tables 7.3 and A6.

Table E3b. Renewable Energy Consumption by the Electric Power Sector (Part 2 of 2)
(Trillion Btu)

	Electric Power Sector												Electric Power Sector Total
	Nonutility Power Producers ^a							Electricity Trade ^b					
	Hydro-power ^c	Wood ^d	Waste ^e	Geo-thermal ^f	Solar ^g	Wind ^h	Total	Hydropower ^c		Geo-thermal Imports	Total Net Imports		
								Imports	Exports				
1973 Total	35	NA	NA	NA	NA	NA	35	175	27	(i)	148	3,056	
1974 Total	33	NA	NA	NA	NA	NA	33	161	28	(i)	133	3,365	
1975 Total	32	NA	NA	NA	NA	NA	32	117	53	(i)	64	3,291	
1976 Total	33	NA	NA	NA	NA	NA	33	114	25	(i)	89	3,146	
1977 Total	33	NA	NA	NA	NA	NA	33	210	29	(i)	182	2,597	
1978 Total	32	NA	NA	NA	NA	NA	32	220	15	(i)	204	3,209	
1979 Total	34	NA	NA	NA	NA	NA	34	233	23	(i)	211	3,230	
1980 Total	E 33	NA	NA	NA	NA	NA	E 33	260	43	(i)	217	3,232	
1981 Total	E 33	NA	NA	NA	NA	NA	E 33	379	32	(i)	347	3,232	
1982 Total	E 33	NA	NA	NA	NA	NA	E 33	343	37	(i)	306	3,680	
1983 Total	E 33	NA	NA	NA	NA	NA	E 33	407	35	(i)	372	4,032	
1984 Total	E 33	NA	NA	NA	NA	NA	E 33	441	27	(i)	414	3,974	
1985 Total	E 33	NA	NA	NA	NA	NA	E 33	479	52	(i)	428	3,611	
1986 Total	E 33	NA	NA	NA	NA	NA	E 33	425	50	(i)	375	3,678	
1987 Total	E 33	NA	NA	NA	NA	NA	E 33	544	61	(i)	483	3,362	
1988 Total	E 33	NA	NA	NA	NA	NA	E 33	401	73	(i)	328	2,897	
1989 Total	90	279	94	117	6	24	609	200	40	11	171	3,763	
1990 Total	100	308	124	152	7	32	722	99	(s)	11	110	3,982	
1991 Total	99	338	151	167	8	32	794	138	(s)	15	153	4,061	
1992 Total	97	360	171	174	7	30	838	201	(s)	19	219	3,769	
1993 Total	117	370	180	198	9	31	905	238	11	18	246	4,104	
1994 Total	135	382	184	205	8	36	951	309	(s)	27	337	4,002	
1995 Total	151	369	199	201	8	33	960	291	17	19	293	4,426	
1996 Total	169	372	202	207	9	35	994	306	7	14	313	4,861	
1997 Total	183	347	200	191	9	33	963	281	37	(s)	244	4,877	
1998 Total	150	321	207	201	9	31	918	269	46	1	225	4,468	
1999 January	13	35	E 23	15	(s)	2	E 88	i14	i8	i(s)	E 6	392	
February	17	28	E 21	13	(s)	2	E 83	i13	i7	i(s)	E 6	377	
March	18	31	E 22	15	(s)	3	E 89	i16	i10	i(s)	E 7	417	
April	19	30	E 23	13	(s)	4	E 90	i25	i7	i(s)	E 18	384	
May	17	30	E 23	23	1	6	E 101	i25	i6	i(s)	E 18	403	
June	13	30	E 23	27	1	6	E 100	i23	i5	i(s)	E 18	417	
July	13	34	E 23	29	1	6	E 107	i23	i5	i(s)	E 19	416	
August	12	33	E 23	30	1	5	E 105	i23	i3	i(s)	E 20	377	
September	13	39	E 22	29	1	4	E 107	i30	i3	i(s)	E 27	339	
October	14	32	E 20	30	1	3	E 100	i30	i7	i(s)	E 23	319	
November	13	30	E 22	28	(s)	2	E 95	i30	i5	i(s)	E 25	327	
December	37	30	E 23	28	(s)	3	E 121	i27	i7	i(s)	E 21	386	
Total	202	382	E 267	280	9	46	E 1,186	280	73	1	208	4,553	
2000 January	23	35	E 20	25	(s)	4	E 107	i25	i3	0	E 22	371	
February	19	33	E 19	22	(s)	4	E 98	i27	i3	0	E 24	338	
March	23	34	E 20	22	1	4	E 105	i25	i4	0	E 20	381	
April	25	33	E 20	23	1	5	E 106	i25	i5	0	E 20	399	
May	24	31	E 20	24	1	5	E 105	i29	i6	0	E 24	391	
June	23	33	E 20	24	1	4	E 104	i31	i6	0	E 25	370	
July	22	36	E 21	25	1	4	E 109	i35	i3	0	E 32	372	
August	23	34	E 21	26	1	4	E 108	i37	i4	0	E 33	353	
September	22	33	E 20	25	1	4	E 105	i29	i4	0	E 25	301	
October	20	34	E 20	26	1	5	E 105	i17	i4	0	E 13	284	
November	19	33	E 20	26	1	4	E 103	i23	i4	0	E 19	306	
December	21	33	E 20	27	(s)	4	E 105	i22	i12	0	E 10	304	
Total	264	401	E 240	295	9	51	E 1,260	325	59	0	266	4,170	
2001 January	18	34	E 19	27	E (s)	4	E 102	i22	i7	0	E 15	297	
February	18	30	E 21	24	E (s)	5	E 99	i21	i11	0	E 9	276	
March	21	34	E 20	25	E (s)	6	E 106	i24	i8	0	E 16	317	
April	25	31	E 23	23	E 1	7	E 109	i25	i7	0	E 19	295	
May	23	32	E 22	23	E 1	8	E 109	i29	i7	0	E 23	313	
June	21	33	E 22	23	E 1	7	E 107	i25	i6	0	E 19	322	
July	15	38	E 22	25	E 1	7	E 108	i25	i6	0	E 19	299	
7-Month Total	140	233	E 148	170	E 5	44	E 740	E 171	E 51	0	E 121	2,119	
2000 7-Month Total	159	234	E 140	165	5	30	E 734	E 196	E 31	0	E 166	2,623	
1999 7-Month Total	112	218	E 158	135	5	29	E 658	E 140	E 48	E (s)	E 92	2,806	

^a Includes the portion of nonutility power producers' use of renewable energy to produce electricity; excludes the portion used to produce useful thermal output, which is included in "Industrial" on Table E2.

^b Through 1988, all electricity imports and exports are included in "Hydropower." From 1989, includes only electricity imports and exports derived from hydroelectric power or geothermal energy.

^c Conventional hydroelectric power.

^d Wood, wood waste, black liquor, red liquor, spent sulfite liquor, wood sludge, peat, railroad ties, and utility poles.

^e Municipal solid waste, landfill gas, methane, digester gas, liquid acetonitrile waste, tall oil, waste alcohol, medical waste, paper pellets, sludge waste, solid byproducts, tires, agricultural byproducts, closed loop biomass, fish oil, and straw. For 1999 forward, data also include electricity net generation from batteries,

chemicals, hydrogen, pitch, sulfur, and purchased steam.

^f Geothermal electricity net generation.

^g Solar thermal and photovoltaic electricity net generation.

^h Wind electricity net generation.

ⁱ Included in "Hydropower Imports."

^j 1999 and 2000 monthly data are estimated by allocating the annual values into the months in proportion to each month's share of the year's total electricity imports or exports (see Table 7.1). Monthly 2001 estimates use the 2000 shares.

NA=Not available. E=Estimate. (s)=Less than 0.5 trillion Btu.

Notes: Totals may not equal sum of components due to independent rounding. Geographic coverage is the 50 States and the District of Columbia.

Sources: See end of section.

Sources for Table E2

Wood, Residential

1973-1979—Energy Information Administration (EIA), *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2.

1980-1983—EIA, *Estimates of U.S. Wood Energy Consumption 1980-1983*, Table ES1.

1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 1.

1985 and 1986—Values interpolated.

1987—EIA, *Estimates of Biofuels Consumption in the United States During 1987*, Table 2.

1988—Value interpolated.

1989—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 1.

1990-1993—EIA, *Renewable Energy Annual 1995*, Table 6.

1994-1997—EIA, *Renewable Energy Annual 1999*, Table 6.

1998 and 1999—EIA, *Renewable Energy Annual 2000*, Table 6.

2000 forward—EIA, Office of Coal, Nuclear, Electric and Alternate Fuels (CNEAF), estimates.

Wood, Commercial

1973-1979—EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2.

1980-1983—EIA, *Estimates of U.S. Wood Energy Consumption 1980-1983*, Table ES1.

1984—EIA, CNEAF, estimate.

1985-1992—Values interpolated.

1993—EIA, *Renewable Energy Annual 1995*, Table 6.

1994-1996—EIA, *Renewable Energy Annual 1999*, Table 6.

1997—EIA, *Renewable Energy Annual 2000*, Table 6.

1998 forward—EIA, CNEAF, estimates.

Wood, Industrial

1973-1979—EIA, *Estimates of U.S. Wood Energy Consumption from 1949 to 1981*, Table A2.

1980-1983—EIA, *Estimates of U.S. Wood Energy Consumption 1980-1983*, Table ES1.

1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 1.

1985 and 1986—Values interpolated.

1987—EIA, *Estimates of Biofuels Consumption in the United States During 1987*, Table 2.

1988—Value interpolated.

1989—American Paper Institute, *Fact Sheet on 1990 Energy Use in the U.S. Pulp and Paper Industry* (July 1991), total pulp and paper industry wood consumption, minus nonutility power producers' use of wood to produce electricity (see Table E3b).

1990-1993—EIA, *Renewable Energy Annual 1995*, Table 6, total industrial wood consumption, minus nonutility power producers' use of wood to produce electricity (see Table E3b).

1994-1997—EIA, *Renewable Energy Annual 1999*,

Table 6, total industrial wood consumption, minus nonutility power producers' use of wood to produce electricity (see Table E3b).

1998 forward—EIA, CNEAF, estimates for total industrial wood consumption, minus nonutility power producers' use of wood to produce electricity (see Table E3b).

Waste, Industrial

1981—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8, total waste consumption, minus electric utilities' use of waste to produce electricity (see Table E3a).

1982 and 1983—EIA, CNEAF, estimates for total waste consumption, minus electric utilities' use of waste to produce electricity (see Table E3a).

1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8, total waste consumption, minus electric utilities' use of waste to produce electricity (see Table E3a).

1985 and 1986—Values interpolated.

1987—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 8, total waste consumption, minus electric utilities' use of waste to produce electricity (see Table E3a).

1988—Value interpolated.

1989 forward—EIA, CNEAF, estimates for total waste consumption, minus electric utilities' and nonutility power producers' use of waste to produce electricity (see Tables E3a and E3b).

Alcohol Fuels

1981—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10.

1982 and 1983—EIA, CNEAF, estimates.

1984—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10.

1985 and 1986—Values interpolated.

1987—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10.

1988—Value interpolated.

1989—EIA, *Estimates of U.S. Biofuels Consumption 1990*, Table 10.

1990-1992—EIA, *Renewable Energy Annual 1995*, Table 6.

1993 forward—EIA, *Petroleum Supply Monthly*, Tables 2 and 28; and Table A1.

Geothermal

1989 forward—John Lund, Oregon Institute of Technology Geoheat Center, unpublished data.

Solar

1989-1991—EIA, CNEAF, estimates.

1992 and 1993—EIA *Renewable Energy Annual 1997*, Table 2.

1994-1998—EIA *Renewable Energy Annual 1999*, Table 2.

1999—EIA, *Renewable Energy Annual 2000*, Table 2.

2000 forward—EIA, CNEAF, estimates.

Sources for Table E3b

Nonutility Power Producers, Hydropower

1973-1978—Federal Power Commission (FPC), Form FPC-4, “Monthly Power Plant Report,” for plants with generating capacity exceeding 10 megawatts, and FPC, Form FPC-12C, “Industrial Electric Generating Capacity,” for all other plants; and Table A6.

1979—FPC, Form FPC-4, “Monthly Power Plant Report,” for plants with generating capacity exceeding 10 megawatts, and EIA estimates for all other plants; and Table A6.

1980-1988—Estimated by EIA as the average generation over the 6-year period of 1974-1979; and Table A6.
1989 forward—Tables 7.4 and A6.

Nonutility Power Producers, All Other Fuels

1989 forward—Tables 7.4 and A6.

Electricity Trade

1973-1988—Tables 7.1 and A6.

1989 forward—Trade data from National Energy Board of Canada, the California Energy Commission, analysis by EIA, CNEAF, and Table A6.

